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DECLARATION

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am the translator of the attached documents and certify that the following is a true
translation to the best of my knowledge and belief.

This is December 18, 2009

A handwritten signature in black ink, appearing to read 'Masamichi Matsuda', with a stylized flourish at the end.

MASAMICHI MATSUDA

(Translation)

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[List of Attached Documents]

[Document]	Scope of Claims	1 copy
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[Document]	Specification	1 copy
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[Document]	Abstract	1 copy
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[Document Name] Scope of Claims

[Claim 1]

A beam spot positioning method of an optical disk for an optical information apparatus provided with

an optical head apparatus including an objective lens, a focus driving apparatus of said objective lens, and a laser light source,

a motor that rotates said optical disk, and an electric circuit that receives a signal obtained from said optical head apparatus and that controls and drives said motor, said objective lens, and said laser light source based on said signal, the method characterized by:

moving said objective lens in a direction perpendicular to an information recording surface of said optical disk by said focus driving apparatus when a command for reproducing said optical disk is issued from said electric circuit, while causing said laser diode provided in said optical head apparatus to emit light;

defining that a slice level voltage $G <$ a focus error signal reference voltage, and setting a time point when a magnitude of a focus error signal obtained from said optical head apparatus establishes the slice level voltage $G >$ the focus error signal voltage as a first focus error signal detection point;

subsequently keeping said objective lens to move further toward said optical disk up to a predetermined amount (L), and turning ON a focus servo control when said electric circuit again detects "the focus error signal detection slice level voltage $G >$ the focus error signal voltage"; and

moving said objective lens in an opposite direction when a second focus error signal detection (the focus error signal detection slice level voltage $G >$ the focus error signal voltage) is not achieved even though said objective lens is moved toward said optical disk by said predetermined amount (L) after said first focus error signal detection point (the focus error signal detection slice level voltage $G >$ the focus error signal voltage), turning ON the focus servo at a time point of detection again of the first focus error signal to apply the focus servo and carry out data read.

[Claim 2]

The beam spot positioning method according to claim 1, characterized by:

instead of defining that the slice level voltage $G <$ the focus error signal reference voltage,

defining that the slice level voltage $G >$ the focus error signal reference voltage;

setting a time point when the magnitude of the focus error signal obtained from the optical head apparatus establishes the slice level voltage $G < \text{the focus error signal voltage}$ as the first focus error signal detection point;

subsequently keeping the objective lens to move further toward the optical disk up to the predetermined amount (L), and turning ON the focus servo control when said electric circuit again detects "the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$ "; and

moving said objective lens in the opposite direction when the second focus error signal detection (the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$) is not achieved even though said objective lens is moved toward said optical disk by said predetermined amount (L) after said first focus error signal detection point (the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$), turning ON the focus servo at a time point of detection again of the first focus error signal to apply the focus servo and carry out the data read.

[Claim 3]

The beam spot positioning method according to claim 1, wherein

a focus error signal detection slice level voltage H of a reverse polarity of the focus error signal detection slice level voltage G is further provided, and the first focus error detection is defined to be achieved when detecting both of (1) the focus error signal detection slice level voltage $H <$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage.

[Claim 4]

The beam spot positioning method according to claim 2, wherein

a focus error signal detection slice level voltage H of a reverse polarity of the focus error signal detection slice level voltage G is further provided, and the first focus error detection is defined to be achieved when detecting both of (1) the focus error signal detection slice level voltage $H >$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G <$ the focus error signal voltage.

[Claim 5]

The beam spot positioning method according to claim 1, wherein

the second focus error detection is defined to be achieved when detecting any one (and both) of (1) the focus error signal detection slice level voltage $H <$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage.

[Claim 6]

The beam spot positioning method according to claim 2, wherein

the first focus error detection is defined to be achieved when detecting any one (and both) of (1) the focus error signal detection slice level voltage $H >$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G <$ the focus error signal voltage.

[Claim 7]

The beam spot positioning method according to any one of claims 1 to 6, wherein

the predetermined amount (L) is set to a value obtained by dividing a maximum value d of a distance between recording layers by a refractive index n of the optical

disk and further adding a sensitivity difference c of the focus driving apparatus thereto, that is,

$$L = d/n \times (1+c)$$

where c is approximately 0.1 to 0.3.

[Claim 8]

An optical information apparatus characterized in that:

said optical information apparatus performs a beam spot positioning operation by said beam spot positioning method according to any one of claims 1 to 7.

[Claim 9]

A computer comprising:

the optical information apparatus according to claim 8,

an input apparatus or input terminal for inputting information,

an arithmetic apparatus for performing operations based on information input from said input apparatus and information reproduced by said optical information apparatus, and

an output apparatus or output terminal for displaying or outputting the information output from said input apparatus, the information reproduced from said optical

information apparatus, and the operation results obtained by said arithmetic apparatus.

[Claim 10]

An optical disk player comprising:

the optical information apparatus according to claim 8, and

a decoder for converting information signal to image, said information signal being obtained from said optical information apparatus

[Claim 11]

A car navigation system comprising:

the optical information apparatus according to claim 8, and

a decoder for converting information signal to image, said information signal being obtained from said optical information apparatus.

[Claim 12]

An optical disk recorder comprising:

the optical information apparatus according to claim 8, and

an encoder for converting image information to information which is recorded by said optical information apparatus.

[Claim 13]

An optical disk server comprising:

the optical information apparatus according to claim 8, and

an input/output terminal for exchanging information with outside.

[Document Name]	Description
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[Title of the Invention]

BEAM SPOT POSITIONING METHOD AND OPTICAL INFORMATION APPARATUS, COMPUTER, OPTICAL DISK PLAYER, CAR NAVIGATION SYSTEM, OPTICAL DISK RECORDER, AND OPTICAL DISK SERVER

[Technical Field]

[0001]

The present invention relates to an optical information apparatus (optical information apparatus) which records/reproduces or erases information stored in an optical information medium such as an optical disk, a beam spot positioning method of the optical information apparatus, and a system to which they are applied (such as a computer, an optical disk player, a car navigation system, an optical disk recorder, and an optical disk server.)

[Background Art]

[0002]

An optical memory technology using an optical disk having a pit-shaped pattern as a high-density, large-volume storage medium has been put to practical use with its application range being expanded to a digital audio disk, video disk, document file disk, data file,

and so on. The function of successfully recording/reproducing information onto/from an optical disk through a finely narrowed light beam with a high degree of reliability can be roughly divided into a condensing function for forming a micro spot narrowed down to a diffraction limit, optical system focus control (focus servo), tracking control and pit signal (information signal) detection.

[0003]

In recent years, with the advance in optical system design technologies and shortened wavelengths of a semiconductor laser serving as a light source, an optical disk having a higher-density storage capacity than a conventional one is being developed. As an approach to realizing higher-density storage capacities, a method of increasing numerical aperture (NA) at the side of the optical disk in a condensing optical system which condenses a light beam on the optical disk to a micro level is under study. The problem in that case is an increase in the amount of aberration due to an inclination (so-called tilt) of an optical axis. Increasing NA increases the amount of aberration which occurs due to tilt. To prevent this, the thickness of the substrate (base material) of the optical disk may be reduced.

[0004]

A compact disk (CD) which can be said to be the first generation optical disk uses infrared light (wavelength λ_3 : 780 nm to 820 nm), an objective lens having an NA of 0.45 and has a disk base material of 1.2 mm in thickness. The DVD, the second generation, uses red light (wavelength λ_2 : 630 nm to 680 nm, standard wavelength 650 nm), an objective lens having an NA of 0.6 and a disk base material of 0.6 mm in thickness. The optical disk, the third generation, uses blue light (wavelength λ_1 : 390 nm to 415 nm, standard wavelength 405 nm), an objective lens having an NA of 0.85 and a disk base material of 0.1 mm in thickness.

[0005]

In the present specification, the thickness of the substrate refers to a thickness from the plane onto which a light beam impinges in the optical disk (or an information recording medium) to the information recording surface.

[0006]

Furthermore, for the purpose of realizing a larger-capacity optical disk, a disk having a multi-layer structure with two or more recording layers is available on the market or under study. When focus control is initially applied to such a disk having a multi-layer structure from a state in which focus control (focus servo) is not functioning yet, that is, beam spot positioning

is performed, it is important to focus on a desired recording layer in which data such as various disk characteristics is written and position the beam spot, also for the purpose of shortening a wait time until an operation is started. A conventionally proposed beam spot positioning method for a two-layer optical disk will be explained below.

[0007]

Figure 10 is a flow chart showing a beam spot positioning method for the conventional two-layer optical disk, Figure 11 illustrates a focus error signal waveform and Figure 12 illustrates a positional relationship between the optical disk and objective lens during beam spot positioning for the conventional two-layer optical disk. In Figure 12, reference numeral 120 denotes a two-layer optical disk whose information recording layer has a two-layer structure, 130 denotes an objective lens, and reference numeral 170 denotes a focus driving apparatus which drives the objective lens 130 in a direction perpendicular to a plane of the optical disk.

[0008]

First, in Figure 10, When a reproduction command on the two-layer optical disk 120 is issued, a laser diode is caused to emit light, then the focus driving apparatus 170 is driven and the objective lens 130 is moved within

a predetermined movement range. The control circuit (not shown) turns ON the focus servo. When an optical head detects the focus error signal of the first layer (a waveform A in Figure 3) while the objective lens 130 is moving, the focus servo is started using this focus error signal of the first layer as a control signal, and a data read of the first layer is carried out. Next, when a data read of the second layer is carried out, a focus jump is made to point D in Figure 3 which is the position of the in-focus point of the second layer after starting the focus servo on the first layer (a movement from a state in which the beam spot is positioned at the first layer shown in Figure 12(b) to a state in which the beam spot is positioned at the second layer shown in Figure 12(c)), and then the focus servo is started using the focus error signal of the second layer (a waveform C in Figure 3) as a control signal and a data read of the second layer is carried out.

[0009]

According to the beam spot positioning method for the above described two-layer optical disk, when a data read is performed on the second layer, the focus servo of the first layer is started first, and then a focus jump is made to start the focus servo for the second layer.

For this reason, a time is required until a data read of the second layer.

[0010]

Thus, a beam spot positioning method intended to make data access in a short time using a drive apparatus which records/reproduces data onto/from a two-layer optical disk is disclosed in Patent Document 1. Figure 13 is a flow chart showing a beam spot positioning method for a two-layer optical disk of the conventional example, Figure 14 illustrates a focus error signal waveform and Figure 12 illustrates the positional relationship between the two-layer optical disk 120 and objective lens 13 during beam spot positioning.

[0011]

When a reproduction command for the two-layer optical disk 120 is issued, the laser diode is caused to emit light (initial state shown in Figure 12). Then, the focus driving apparatus 170 moves the objective lens 130 in a direction perpendicular to the information recording surface of the two-layer optical disk 120 within a predetermined range of distance. As the objective lens 130 moves, the focus error signal of the first layer is detected (a signal waveform A in Figure 14) and monitored, and then, a period is detected, during which the level voltage of the focus error signal is lower than a focus

error signal detection slice level voltage F of the first layer.

[0012]

Then, when a time point at which the focus error signal voltage falls below the first layer focus error signal detection slice level voltage F is detected again, the focus servo is turned ON.

[0013]

Next, the focus error signal C of the second layer which the objective lens 130 detects while moving, is monitored (a signal waveform C in Figure 14) and if it is detected that the objective lens 130 has reached the position corresponding to an in-focus point of the second layer (point D in Figure 14), the focus servo is started using the second layer focus error signal C as a control signal and a data read of the second layer is performed.

[Patent Document 1] JP laid-open 9-161284

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0014]

However, by using the above described conventional beam spot positioning method,

when the reflective index of the second layer is low and the focus error signal of the second layer cannot be detected, for example, the objective lens may continue to move in search of the focus error signal of the second layer, and collide with the optical disk, causing damage to the objective lens or optical disk. Further, if the reflective index of the first layer is low and the focus error signal of the first layer cannot be detected, the focus error signal of the second layer may be mistaken for the focus error signal of the first layer, and the objective lens may continue to move in search of the next focus error signal, and collide with the optical disk, causing damage to the objective lens or optical disk.
[Means to solve the problems]

[0015]

To solve the above problems, the present invention comprises an optical information apparatus, a computer, an optical disk player, a navigation system, an optical disk recorder, and an optical disk server, etc, as mentioned below.

[0016]

A beam spot positioning method of the present invention is a beam spot positioning method of an optical disk for an optical information apparatus provided with

an optical head apparatus including an objective lens, a focus driving apparatus of said objective lens, and a laser light source,

a motor that rotates said optical disk, and an electric circuit that receives a signal obtained from said optical head apparatus and that controls and drives said motor, said objective lens, and said laser light source based on said signal, the method characterized by:

moving said objective lens in a direction perpendicular to an information recording surface of said optical disk by said focus driving apparatus when a command for reproducing said optical disk is issued from said electric circuit, while causing said laser diode provided in said optical head apparatus to emit light;

defining that a slice level voltage $G < \text{a focus error signal reference voltage}$, and setting a time point when a magnitude of a focus error signal obtained from said optical head apparatus establishes the slice level voltage $G > \text{the focus error signal voltage}$ as a first focus error signal detection point;

subsequently keeping said objective lens to move further toward said optical disk up to a predetermined amount (L), and turning ON a focus servo control when said electric circuit again detects "the focus error

signal detection slice level voltage $G >$ the focus error signal voltage"; and

moving said objective lens in an opposite direction when a second focus error signal detection (the focus error signal detection slice level voltage $G >$ the focus error signal voltage) is not achieved even though said objective lens is moved toward said optical disk by said predetermined amount (L) after said first focus error signal detection point (the focus error signal detection slice level voltage $G >$ the focus error signal voltage), turning ON the focus servo at a time point of detection again of the first focus error signal to apply the focus servo and carry out data read.

[0017]

Further, the present invention is characterized by:

instead of defining that the slice level voltage $G <$ the focus error signal reference voltage,

defining that the slice level voltage $G >$ the focus error signal reference voltage;

setting a time point when the magnitude of the focus error signal obtained from the optical head apparatus establishes the slice level voltage $G <$ the focus error signal voltage as the first focus error signal detection point;

subsequently keeping the objective lens to move further toward the optical disk up to the predetermined amount (L), and turning ON the focus servo control when said electric circuit again detects "the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$ "; and

moving said objective lens in the opposite direction when the second focus error signal detection (the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$) is not achieved even though said objective lens is moved toward said optical disk by said predetermined amount (L) after said first focus error signal detection point (the focus error signal detection slice level voltage $G < \text{the focus error signal voltage}$), turning ON the focus servo at a time point of detection again of the first focus error signal to apply the focus servo and carry out the data read.

[0018]

Further, the present invention is characterized in that a focus error signal detection slice level voltage H of a reverse polarity of the focus error signal detection slice level voltage G is further provided, and the first focus error detection is defined to be achieved when detecting both of (1) the focus error signal detection slice level voltage $H < \text{the focus error signal voltage}$

and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage.

[0019]

Further, the present invention is characterized in that a focus error signal detection slice level voltage H of a reverse polarity of the focus error signal detection slice level voltage G is further provided, and the first focus error detection is defined to be achieved when detecting both of (1) the focus error signal detection slice level voltage $H >$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G <$ the focus error signal voltage.

[0020]

Further, the present invention is characterized in that the second focus error detection is defined to be achieved when detecting any one (and both) of (1) the focus error signal detection slice level voltage $H <$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage.

[0021]

Further, the present invention is characterized in that the first focus error detection is defined to be achieved when detecting any one (and both) of (1) the focus error signal detection slice level voltage $H >$ the

focus error signal voltage and (2) the focus error signal detection slice level voltage $G <$ the focus error signal voltage.

[0022]

Further, the present invention is characterized in that the predetermined amount (L) is set to a value obtained by dividing a maximum value d of a distance between recording layers by a refractive index n of the optical disk and further adding a sensitivity difference c of the focus driving apparatus thereto, that is,

$$L = d/n \times (1+c)$$

where c is approximately 0.1 to 0.3.

[0023]

An optical information apparatus of the present invention is characterized in that:

said optical information apparatus performs a beam spot positioning operation by said beam spot positioning method according to the present invention.

[0024]

A computer of the present invention is characterized by having:

the optical information apparatus according to the present invention,

an input apparatus or input terminal for inputting information,

an arithmetic apparatus for performing operations based on information input from said input apparatus and information reproduced by said optical information apparatus, and

an output apparatus or output terminal for displaying or outputting the information output from said input apparatus, the information reproduced from said optical information apparatus, and the operation results obtained by said arithmetic apparatus.

[0025]

An optical disk player of the present invention is characterized by having:

the optical information apparatus according to the present invention, and

a decoder for converting information signal to image, said information signal being obtained from said optical information apparatus

[0026]

A car navigation system of the present invention is characterized by having:

the optical information apparatus according to the present invention, and

a decoder for converting information signal to image, said information signal being obtained from said optical information apparatus.

[0027]

An optical disk recorder of the present invention is characterized by having:

the optical information apparatus according to the present invention, and

an encoder for converting image information to information which is recorded by said optical information apparatus.

[0028]

An optical disk server of the present invention is characterized by having:

the optical information apparatus according to the present invention, and

an input/output terminal for exchanging information with outside.

[Effect of the Invention]

[0029]

The present invention exerts the notable effect of being able to perform beam spot positioning in a short time, when basic data such as a type and capability of the disk as well as file composition of written data are written to a recording layer of the deepest part from a surface of a multi-layer disk, for example, a second

layer as the second part from the surface of the disk in a case of a two-layer disk, to the second layer, as well as of reliably avoiding to cause a damage during the beam spot positioning due to collision between the objective lens and the optical disk.

[Best Mode for Carrying Out the Invention]

[0030]

(Embodiment 1)

Figure 1 is an optical information apparatus according to Embodiment 1 of the present invention. In Figure 1, an optical disk 9 (or 10 or 11, same hereinafter) is placed on a turn table 82 and rotated by a motor 64. An optical head apparatus 55 is roughly moved to a track in which desired information of the optical disk exists by a driving apparatus 51 of the optical head apparatus.

[0031]

The optical head apparatus 55 also sends a focus error signal or tracking error signal to an electric circuit 53 in accordance with the positional relationship with the optical disk 10. In response to this signal, the electric circuit 53 sends a signal for inching an objective lens to the optical head apparatus 55. According to this signal, the optical head apparatus 55 carries out focus control and tracking control on the optical disk 9 and

the optical head apparatus 55 reads, writes (records) or erases information.

[0032]

The beam spot positioning method for the multi-layer optical disk of the optical information apparatus as mentioned above will be explained by taking a two-layer disk as an example according to Figures.

[0033]

Further, Figure 2 illustrates a flow chart showing a beam spot positioning method for a two-layer optical disk according to one embodiment of the present invention, Figure 3 illustrates a focus error signal waveform in Figure 2, and Figure 4 illustrates a positional relationship between a two-layer optical disk 121 and objective lens 131 during beam spot positioning.

[0034]

When a command for reproduction from the optical disk is issued from the electric circuit 53, a laser diode provided in the optical head apparatus 55 is caused to emit light (initial state shown in Figure 4(a)). Then, a focus driving apparatus 171 is driven and the objective lens 131 is moved in a direction perpendicular to the information recording surface of the optical disk. At this time, the objective lens 131 is moved by the focus

driving apparatus from a place far from the optical disk to a place closer to the optical disk.

[0035]

At the same time, the electric circuit 53 monitors a focus error signal detected when the objective lens 131 is moving, uit 53 detects a period during which a focus error signal detection slice level voltage $G >$ a focus error signal voltage. This is the case where the slice level G is set such that $G < E$ (a focus error signal reference voltage), and if $G > E$, the electric circuit 53 detects a period during which the focus error signal detection slice level voltage $G <$ the focus error signal voltage.

[0036]

Here, it is desirable that the absolute value of $G-E$ be $1/3$ to $2/3$ of the amplitude of a standard focus error signal voltage. This can avoid the focus error signal of the optical disk surface (J in Figure 3, and (a) in Figure 4) from being mistaken for the focus error signal of the first layer.

[0037]

When the electric circuit 53 has detected that "the focus error signal detection slice level voltage $G >$ the focus error signal voltage", it is recorded in a memory provided within the electric circuit 53 that the detection has been achieved, and the objective lens 131 is kept

moving closer to the optical disk 121. Then, when the electric circuit 53 again detects "a second focus error signal detection slice level voltage $G >$ the focus error signal voltage", the focus servo control is turned ON for the first time.

[0038]

However, in a case where it is not possible to achieve the second focus error signal detection (the second focus error signal detection slice level voltage $G >$ the focus error signal voltage) even when the objective lens 131 is moved toward the optical disk 121 by a predetermined amount (L) after the first focus error signal detection point (the focus error signal detection slice level voltage $G >$ the focus error signal voltage), the objective lens 131 is moved in an opposite direction, and the focus servo is turned ON when the first focus error signal is again detected. It is preferable that the predetermined limiting amount by which the objective lens 131 is moved is set to an amount derived by dividing a maximum value d of a distance between two layers by a refractive index n of the optical disk 121 and then added by a sensitivity difference c of the focus driving apparatus. That is,

$$L = d/n \times (1 + c)$$

where c is approximately from 0.1 to 0.3.

[0039]

In this manner, by limiting the amount of movement of the objective lens, it is possible to avoid collision between the objective lens and the optical disk. Further, by detecting the first and second focus error signals appropriately, it is possible to apply the focus servo directly and in a short time to, in many cases, the second layer. As it is possible to apply the focus servo to at least one of the recording layers of the first layer and the second layer even if the second focus error signal cannot be detected, it is determined which layer it is after data read, and a focus jump is made in a case where it is the first layer to carry out the data read from the second layer. In this manner, it is possible to perform beam spot positioning to the second layer stably in either case.

[0040]

It should be noted, as shown in Figure 3, it is possible to reduce possibility of falsely recognizing a focus error signal J on a surface (a state as shown in Figure 4(a)) as the first focus error signal by further providing a focus error signal detection slice level voltage H of a reverse polarity of the focus error signal detection slice level voltage G and by defining the first focus error detection to be achieved when detecting both of (1) the focus error signal detection slice level voltage

$H <$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage. This is the case when presuming $G < E$. On the contrary, when $G > E$, the first focus error detection (Figure 4 (b)) can be defined to be achieved when detecting both (1) the focus error signal detection slice level voltage $H >$ focus error signal voltage and (2) the focus error signal detection slice level voltage $G <$ focus error signal voltage. The same applied in the following.

[0041]

Further, it is possible to increase the possibility of allowing beam spot positioning to be performed directly to the second layer by defining the second focus error detection (Figure 4 (c)) to be achieved when detecting one of (including both of) (1) the focus error signal detection slice level voltage $H <$ the focus error signal voltage and (2) the focus error signal detection slice level voltage $G >$ the focus error signal voltage. In this case, it should be noted that an absolute value of the slice level voltage H (a difference from E) is desirably from $1/3$ to $2/3$ of amplitude of a standard focus error signal voltage. With this, it is possible to avoid falsely recognizing the focus error signal of the optical disk surface (J in Figure 3) as the focus error signal of the first layer.

[0042]

Furthermore, in the case where the optical disk is a multi-layer disk having three or more layers, after a focus error signal is detected, the objective lens is brought closer to the optical disk by a certain amount and if the next focus error signal can be detected, the objective lens is sent further and if not, the objective lens is moved in the opposite direction and beam spot positioning is performed using the focus error signal detected immediately before. By determining this number of times, it is possible to exert the notable effect of performing direct beam spot positioning to a desired recording layer and avoiding collision between the objective lens and optical disk.

[0043]

(Embodiment 2)

An embodiment of a computer, etc., provided with the optical information apparatus 67 described in Embodiment 1 will be shown below.

[0044]

A computer, optical disk player or optical disk recorder provided with the optical information apparatus of the above described embodiment or adopting the above described recording/reproducing method can perform beam spot positioning to a desired recording layer of a

multilayer optical disk in a short time and prevent collision between the objective lens and optical disk, and can thereby realize a system with excellent operability with a shorter wait time before starting operation of the optical disk.

[0045]

In Figure 5, a computer 100 is constructed of the optical information apparatus 67 according to Embodiment 1, an input apparatus 65 such as a keyboard, mouse, or touch panel for inputting information, an arithmetic unit 641 such as a central processing unit (CPU), etc., which performs operations based on information input from the input apparatus and information read from the optical information apparatus 67 and an output apparatus 61 such as a CRT, liquid crystal display apparatus or printer which displays information such as operation results of the arithmetic unit.

[0046]

(Embodiment 3)

An embodiment of an optical disk player provided with the optical information apparatus 67 described in Embodiment 1 is shown in Figure 6.

[0047]

In Figure 6, an optical disk player 77 is constructed of the optical information apparatus 67 according to

Embodiment 1 and an apparatus which converts an information signal obtained from the optical information apparatus to an image (decoder 66, for example).

Furthermore, this structure can also be used as a car navigation system. Furthermore, the apparatus of the present invention may also be used in a mode provided with a display apparatus 120 such as a liquid crystal monitor.

[0048]

(Embodiment 4)

An embodiment of an optical disk recorder provided with the optical information apparatus described in Embodiment 1 will be shown below.

[0049]

Embodiment 4 will be explained using Figure 7. In Figure 7, an optical disk recorder is constructed of the optical information apparatus 67 according to Embodiment 2 and an apparatus which converts image information to information which is recorded in an optical disk by the optical information apparatus (encoder 68, for example). Preferably by also including an apparatus which converts an information signal obtained from the optical information apparatus to an image (decoder 66), it is also possible to reproduce an already recorded portion. The optical disk recorder may also include an output

apparatus 61 such as a CRT, liquid crystal display apparatus, or printer which displays information.

[0050]

(Embodiment 5)

Embodiment 5 will be explained using Figure 8. In Figure 8, an optical information apparatus 67 is the optical information apparatus described in Embodiment 1. Furthermore, an input/output terminal 69 is a wired or wireless input/output terminal which inputs information to be recorded in the optical information apparatus 67 or outputs information read by the optical information apparatus 67 to the outside. This allows the present invention to be used as an information server (optical disk server) which exchanges information with a network, that is, a plurality of devices, for example, a computer, telephone, television tuner, etc., and which is shared by the plurality of devices. This allows optical disks of different types to be stably recorded or reproduced, thus having the effect of being applicable to a wide range of applications. It is also possible to include an output apparatus 61, such as a CRT, liquid crystal display apparatus or printer which displays information.

[0051]

Furthermore, by also including a changer 131 which loads/unloads a plurality of optical disks into/from the optical information apparatus 67, it is possible to produce the effect of recording/storing a large volume of information.

[0052]

Embodiments 2 to 5 have shown the output apparatus 61 and liquid crystal monitor 120 in Figures 5 to 8, but it is needless to say that there can be a commodity mode in which output terminals are provided but the output apparatus 61 and liquid crystal monitor 120 are not provided, but these devices sell separately.

Furthermore, Figure 6 and Figure 7 show no input apparatus, but it is also possible to adopt a commodity mode provided with an input apparatus such as a keyboard, touch panel, mouse, remote control apparatus, etc. On the contrary, in Embodiments 2 to 5 above, it is also possible to adopt a mode in which the input apparatus sells separately and only input terminals for connections with the input apparatus are included.

[Industrial Applicability]

[0053]

The present invention is applicable to wide industrial fields including audio, video, and computer as a large-volume, removable, randomly accessible

information storage apparatus such as various devices using an optical information apparatus which records/reproduces a multi-layer optical disk, for example, video reproducing machine, video recorder, car AV system, audio device, storage apparatus for a computer, home server, business data backup apparatus, etc., and the range of industrial applicability thereof is wide and large.

[Brief Description of Drawings]

[0054]

[Figure 1] Figure 1 is a schematic cross-sectional view of an optical information apparatus according to an embodiment of the present invention;

[Figure 2] Figure 2 illustrates a flow chart showing a beam spot positioning method according to an embodiment of the present invention;

[Figure 3] Figure 3 illustrates a relationship between a focus error signal and slice signal according to an embodiment of the present invention;

[Figure 4] Figures 4 are schematic cross-sectional views of a positional relationship between an optical disk and objective lens according to an embodiment of the present invention;

[Figure 5] Figure 5 is a schematic perspective view of the structure of a computer according to an embodiment of the present invention;

[Figure 6] Figure 6 is a schematic perspective view of the structure of an optical disk player and car navigation system according to an embodiment of the present invention;

[Figure 7] Figure 7 is a schematic perspective view of the structure of an optical disk recorder according to an embodiment of the present invention;

[Figure 8] Figure 8 is a schematic perspective view of the structure of an optical disk server according to an embodiment of the present invention;

[Figure 9] Figure 9 is a schematic cross-sectional view of an optical information apparatus according to a conventional example;

[Figure 10] Figure 10 is a flow chart showing a beam spot positioning method according to the conventional example;

[Figure 11] Figure 11 illustrates a focus error signal according to the conventional example;

[Figure 12] Figures 12 are schematic cross-sectional views of a positional relationship between an optical disk and objective lens according to the conventional example;

[Figure 13] Figure 13 is a flow chart showing a beam spot positioning method according to a conventional example; and

[Figure 14] Figure 14 illustrates a relationship between a focus error signal and slice signal according to the conventional example.

(Description of Symbols)

[0055]

9, 121	Optical disk
131	Objective lens
171	Focus driving apparatus
51	Driving apparatus of optical head apparatus
53	Electric circuit
55	Optical head apparatus
61	Output apparatus
64	Motor
65	Input apparatus
66	Decoder
67	Optical information apparatus
68	Encoder
69	Input/output terminal
77	optical disk player (or car navigation system)
100	Computer
110	Optical disk recorder

130 Optical disk server

[Document Name] ABSTRACT OF DISCLOSURE

[Abstract]

[Problems]

A deep layer of a multi-layer disk could not be accessed in a short time.

[Means for Solving the Problems]

Keeping the objective lens to move further toward the optical disk up to a predetermined amount (L), and turning ON a focus servo control when the electric circuit again detects "the focus error signal detection slice level voltage $G >$ the focus error signal voltage"; and

moving the objective lens in an opposite direction when a second focus error signal detection (the focus error signal detection slice level voltage $G >$ the focus error signal voltage) is not achieved even though the objective lens is moved toward the optical disk by the predetermined amount (L) after the first focus error signal detection point (the focus error signal detection slice level voltage $G >$ the focus error signal voltage), turning ON the focus servo at a time point of detection again of the first focus error signal to apply the focus servo and carry out data read.

[Selected drawing] Figure 2

Fig.1

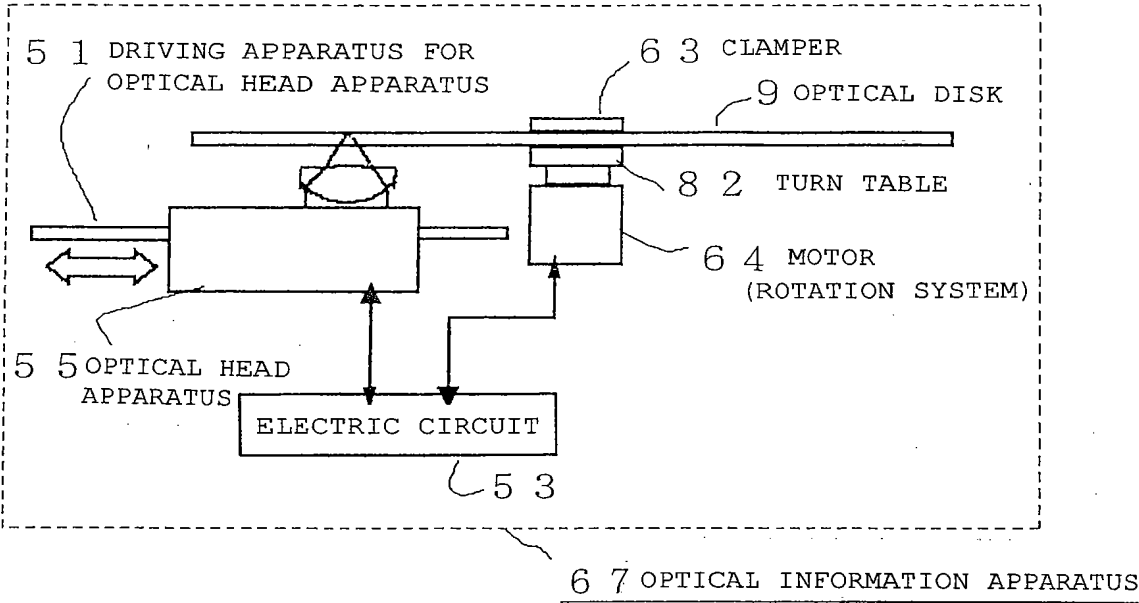
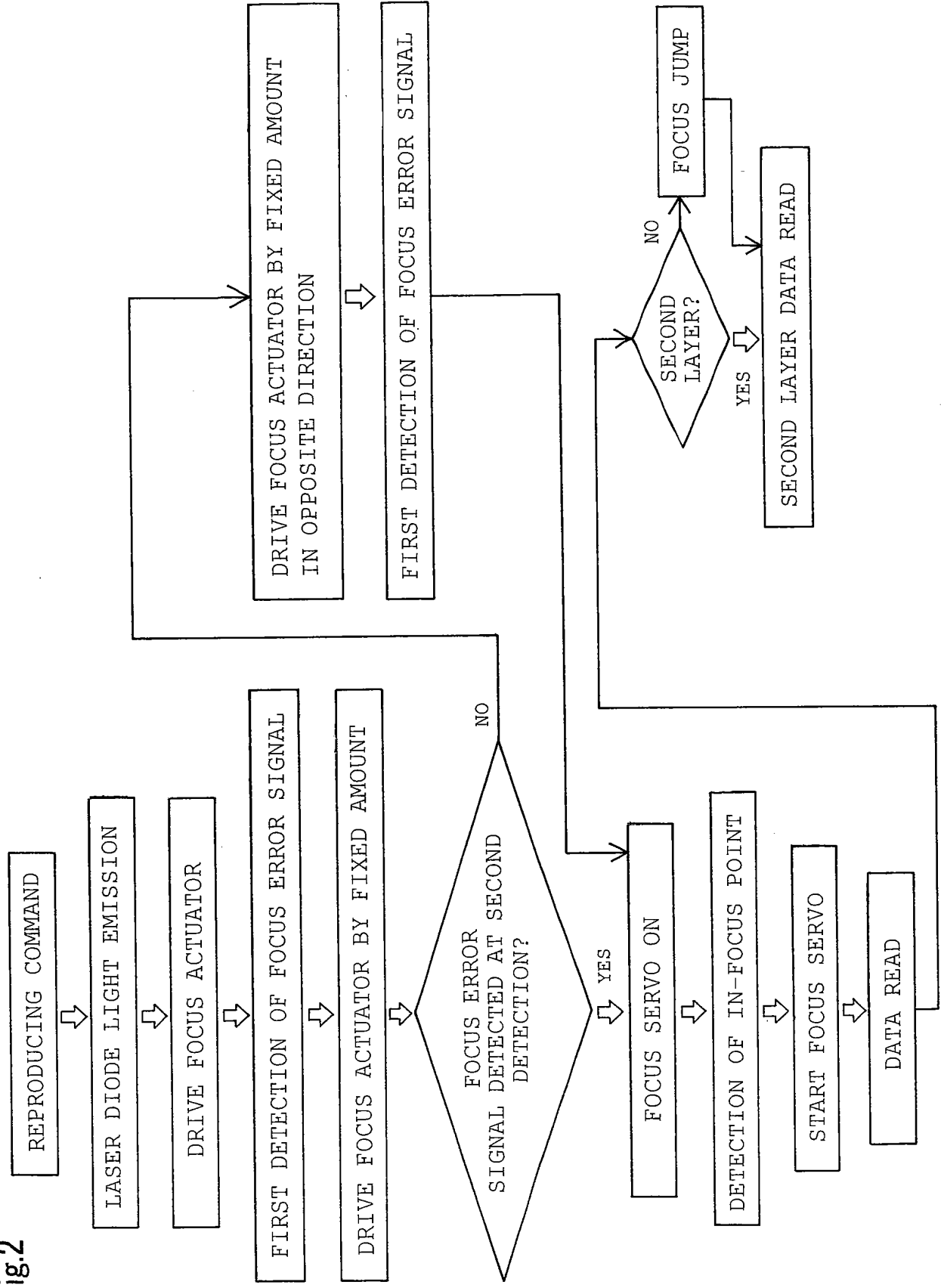


Fig.2



A FIRST LAYER FOCUS ERROR SIGNAL
 B FIRST LAYER IN-FOCUS POINT
 C SECOND LAYER FOCUS ERROR SIGNAL
 D SECOND LAYER IN-FOCUS POINT
 E FOCUS ERROR SIGNAL REFERENCE VOLTAGE
 G FOCUS ERROR SIGNAL
 DETECTION SLICE LEVEL 1
 H FOCUS ERROR SIGNAL
 DETECTION SLICE LEVEL 2
 J SURFACE FOCUS ERROR SIGNAL

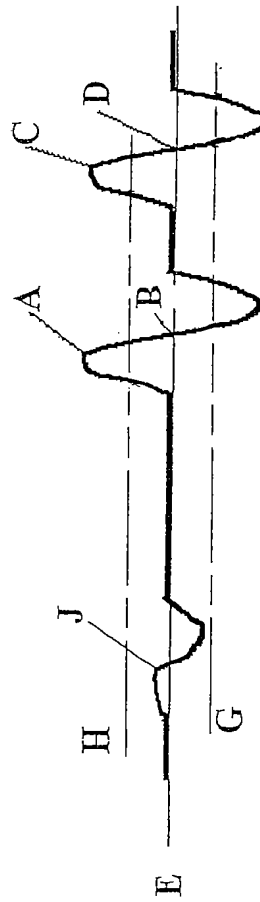


Fig.3

Fig. 4

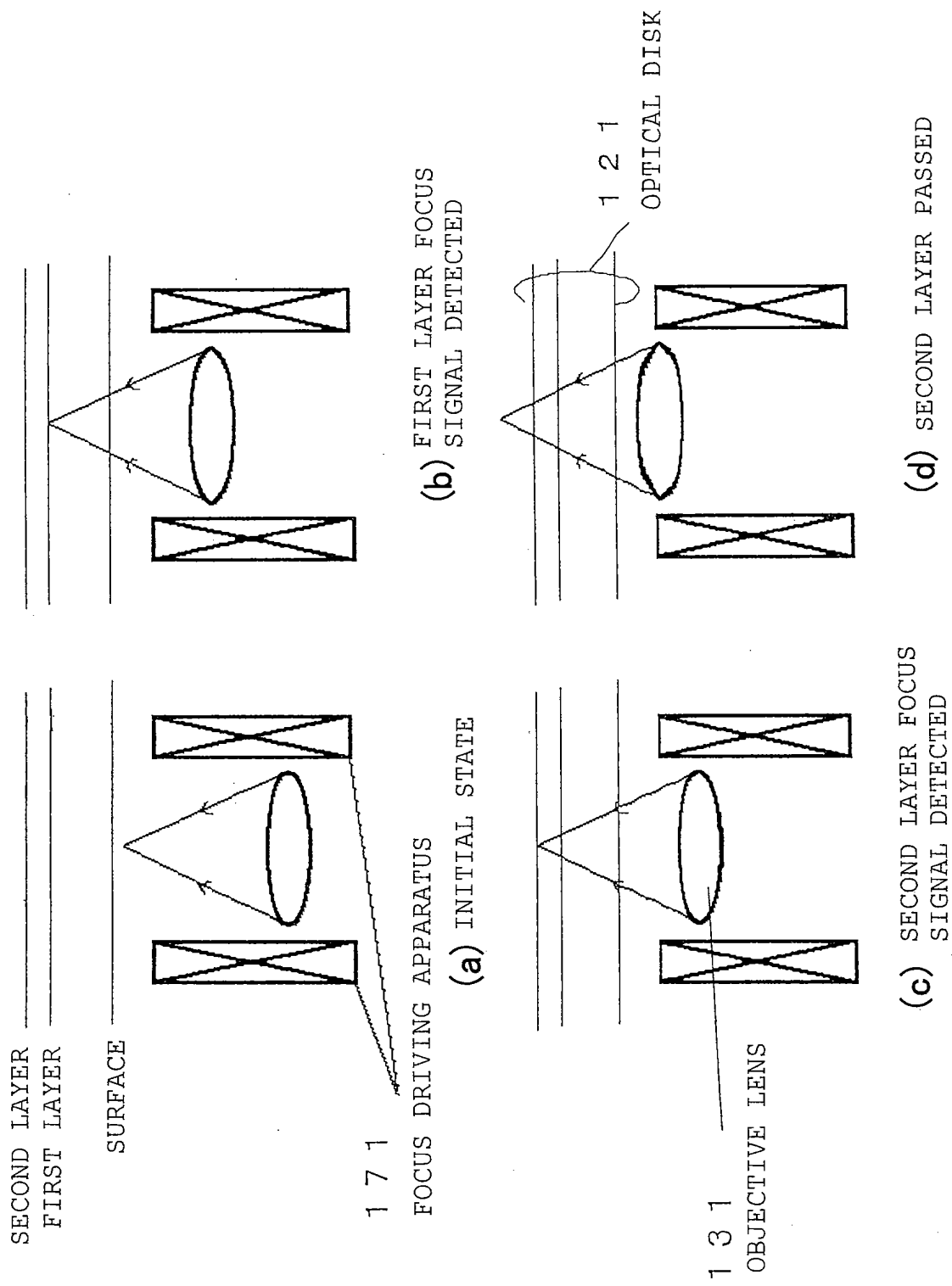


Fig. 5

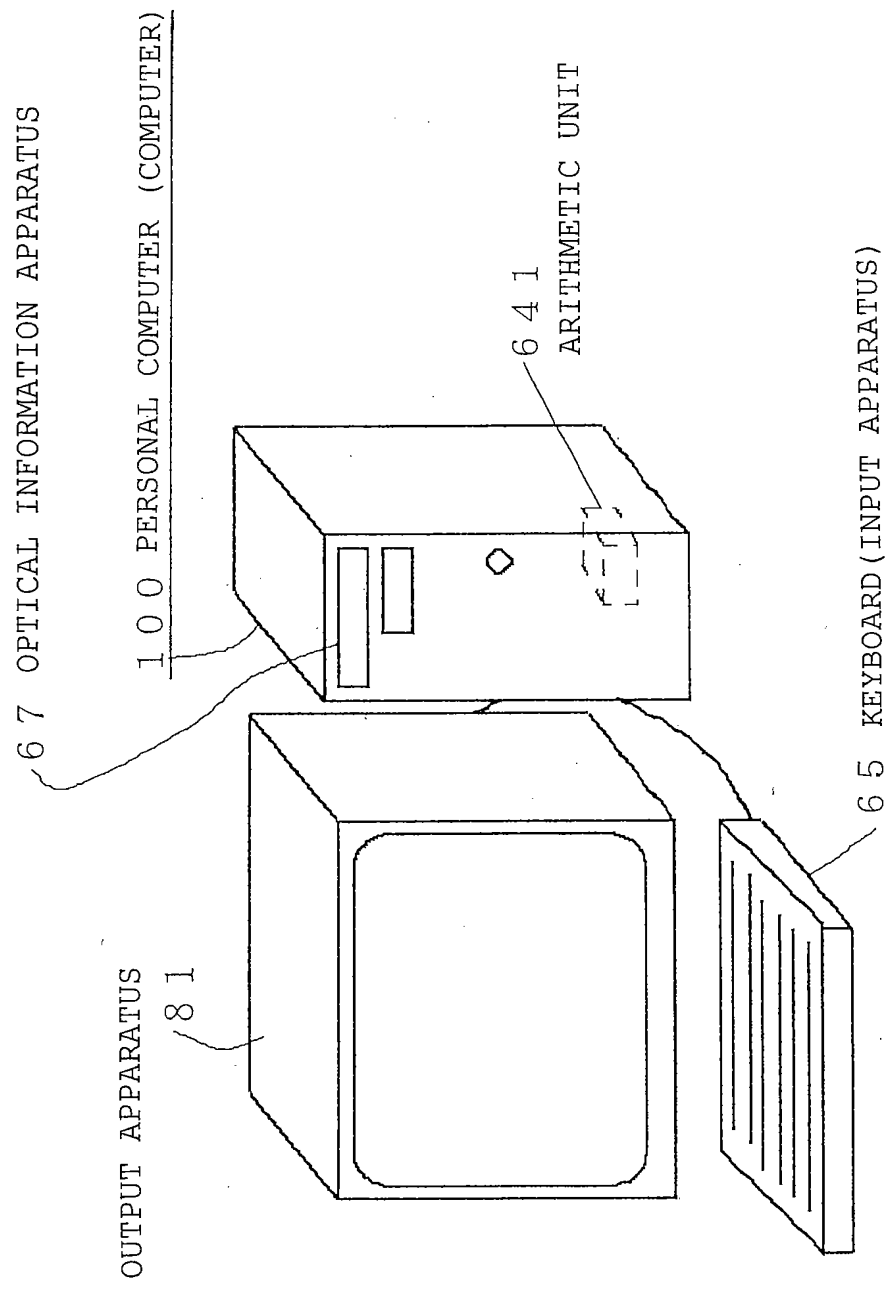


Fig. 6

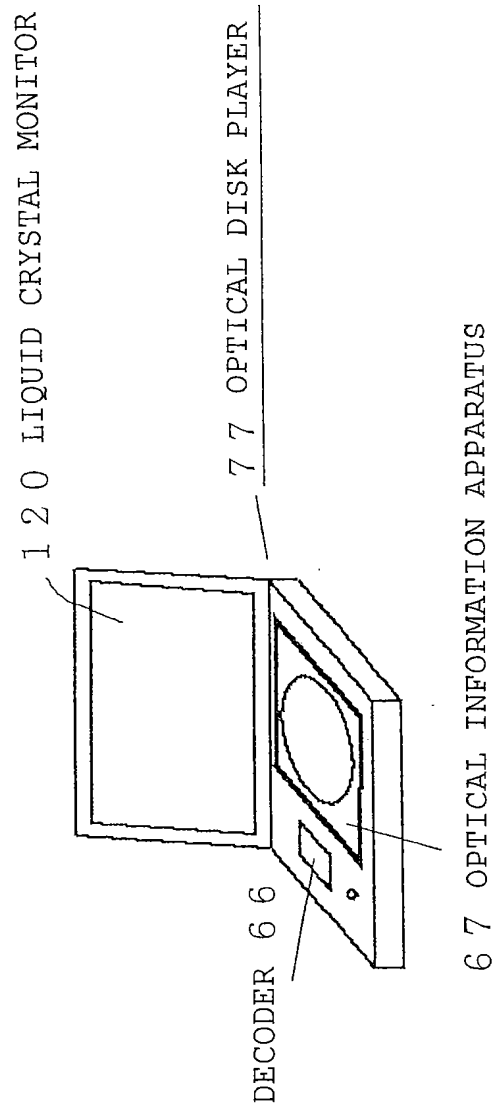


Fig. 7

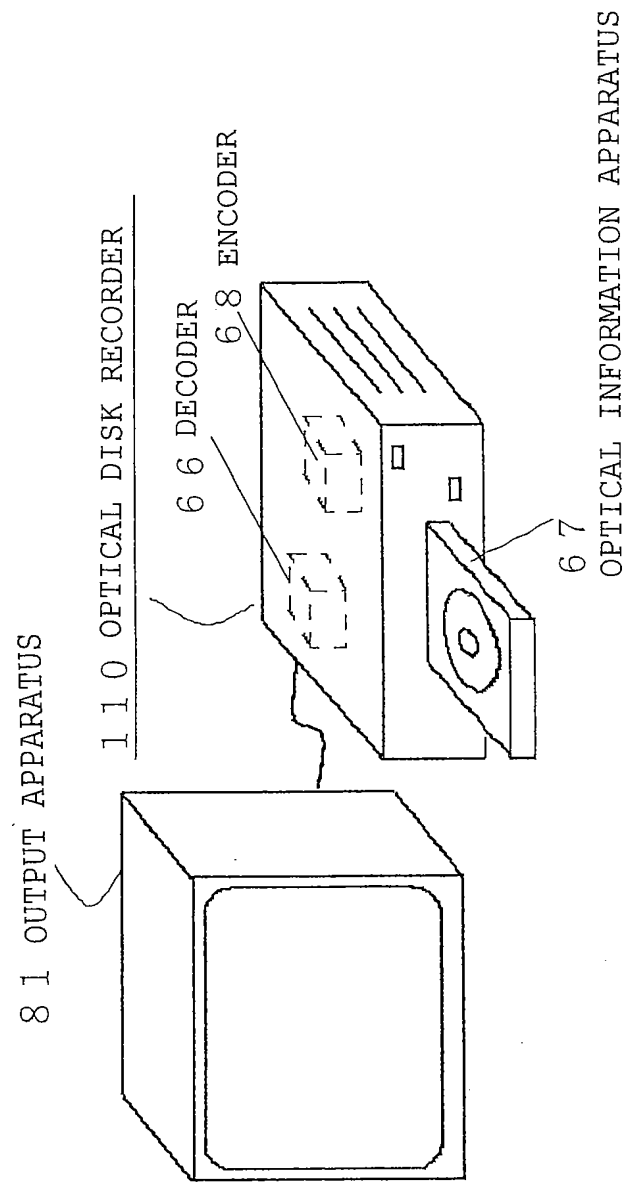


Fig. 8

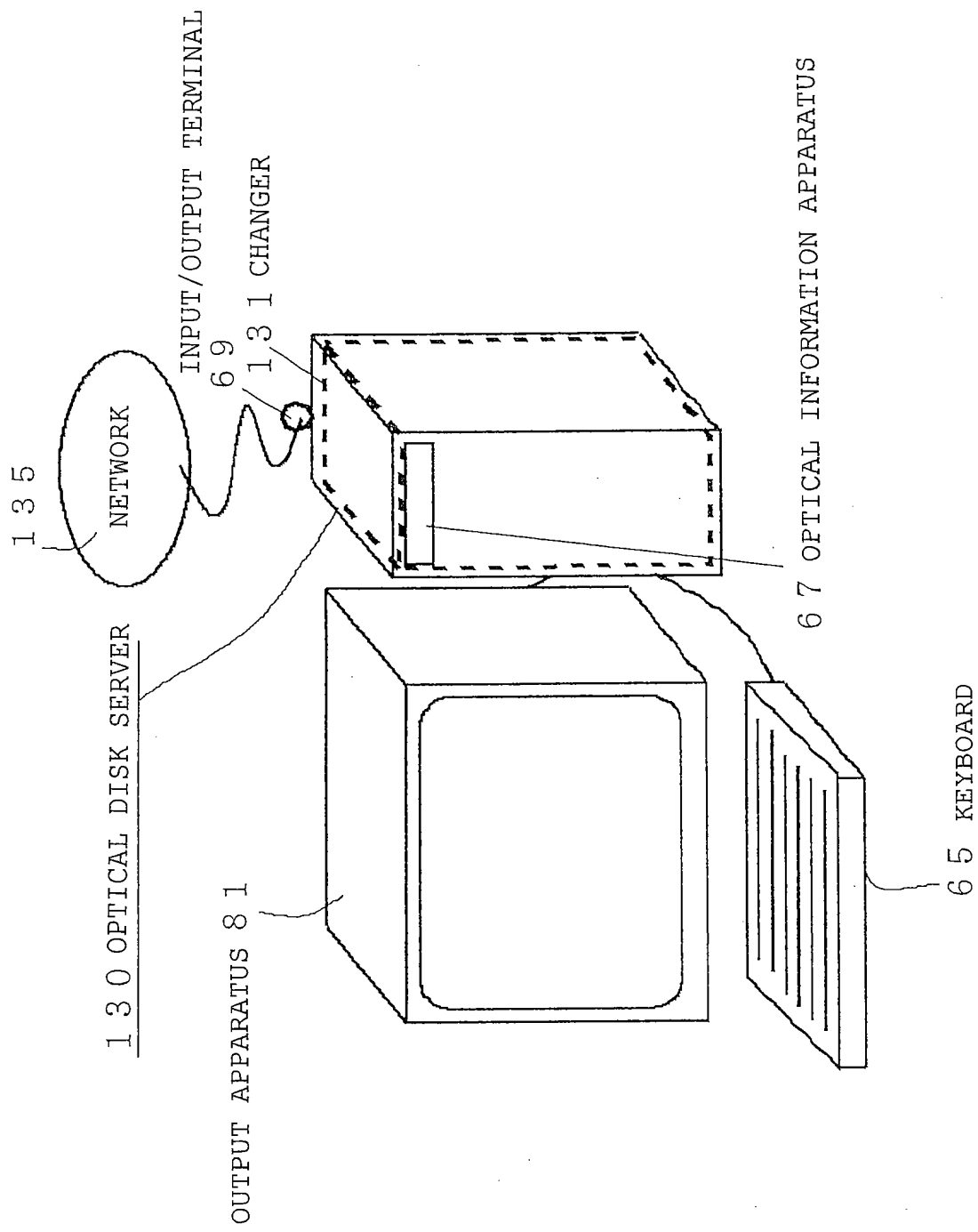


Fig. 9

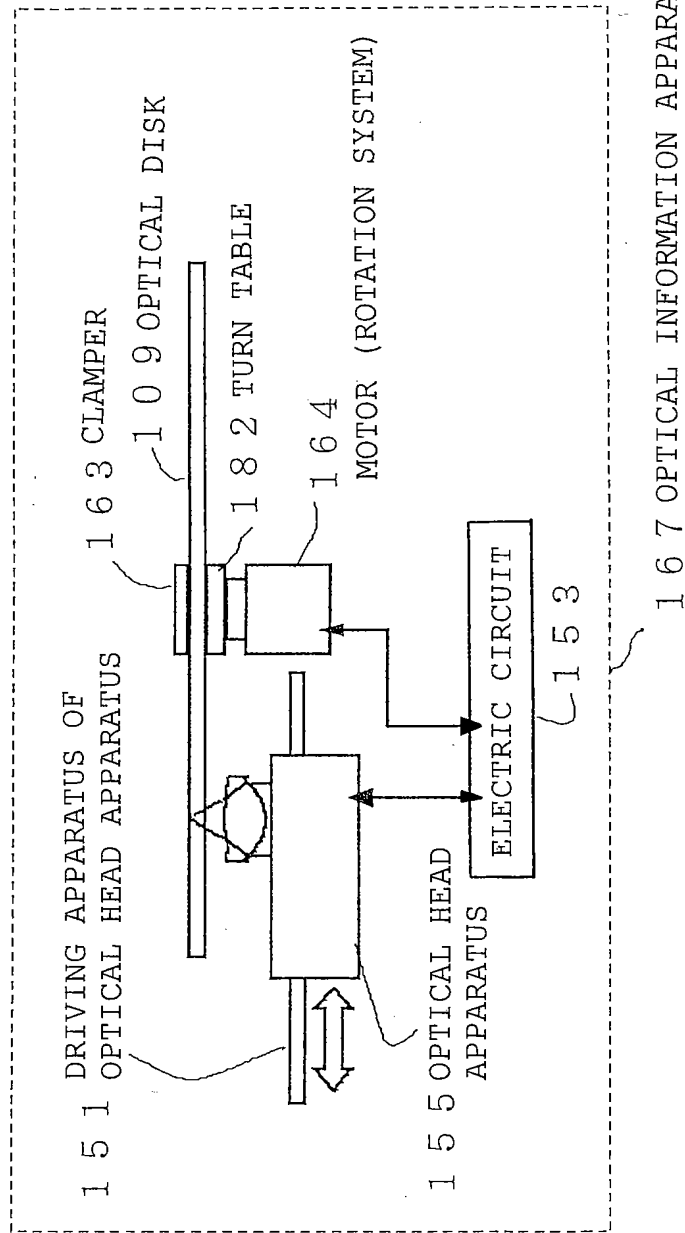


Fig. 10

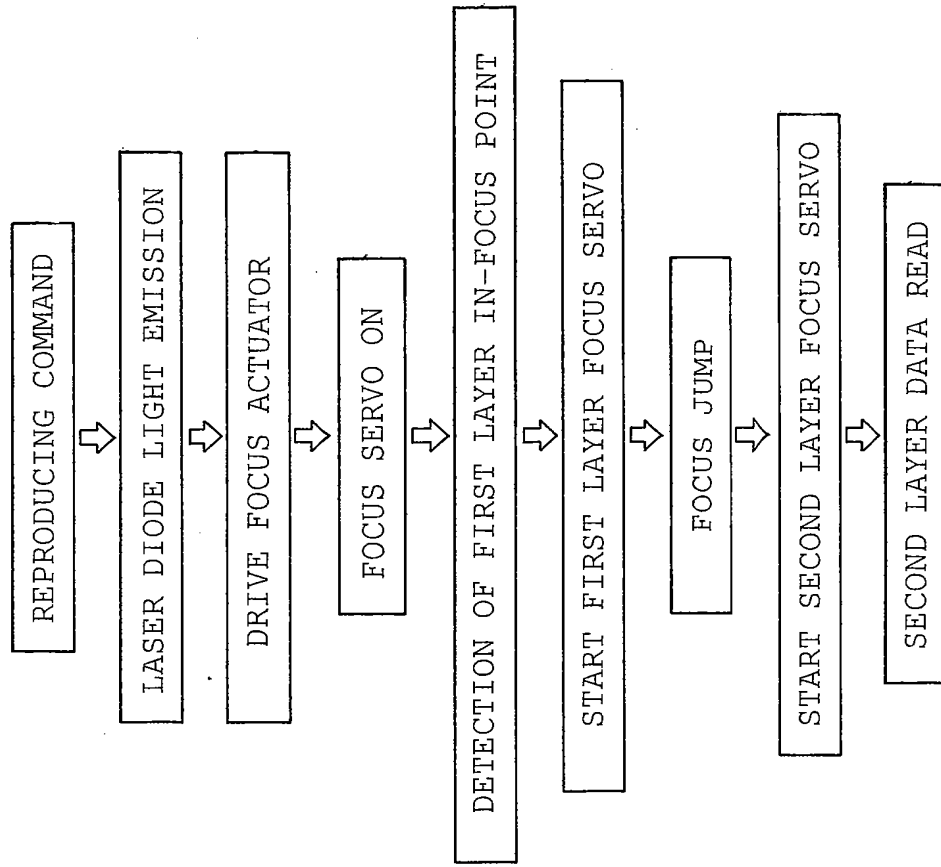


Fig. 11

- A FIRST LAYER FOCUS ERROR SIGNAL
- B FIRST LAYER IN-FOCUS POINT
- C SECOND LAYER FOCUS ERROR SIGNAL
- D SECOND LAYER IN-FOCUS POINT
- E FOCUS ERROR SIGNAL REFERENCE VOLTAGE

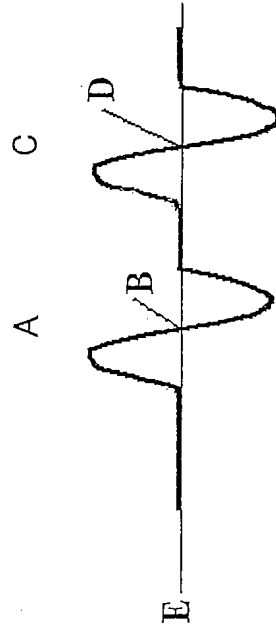


Fig. 12

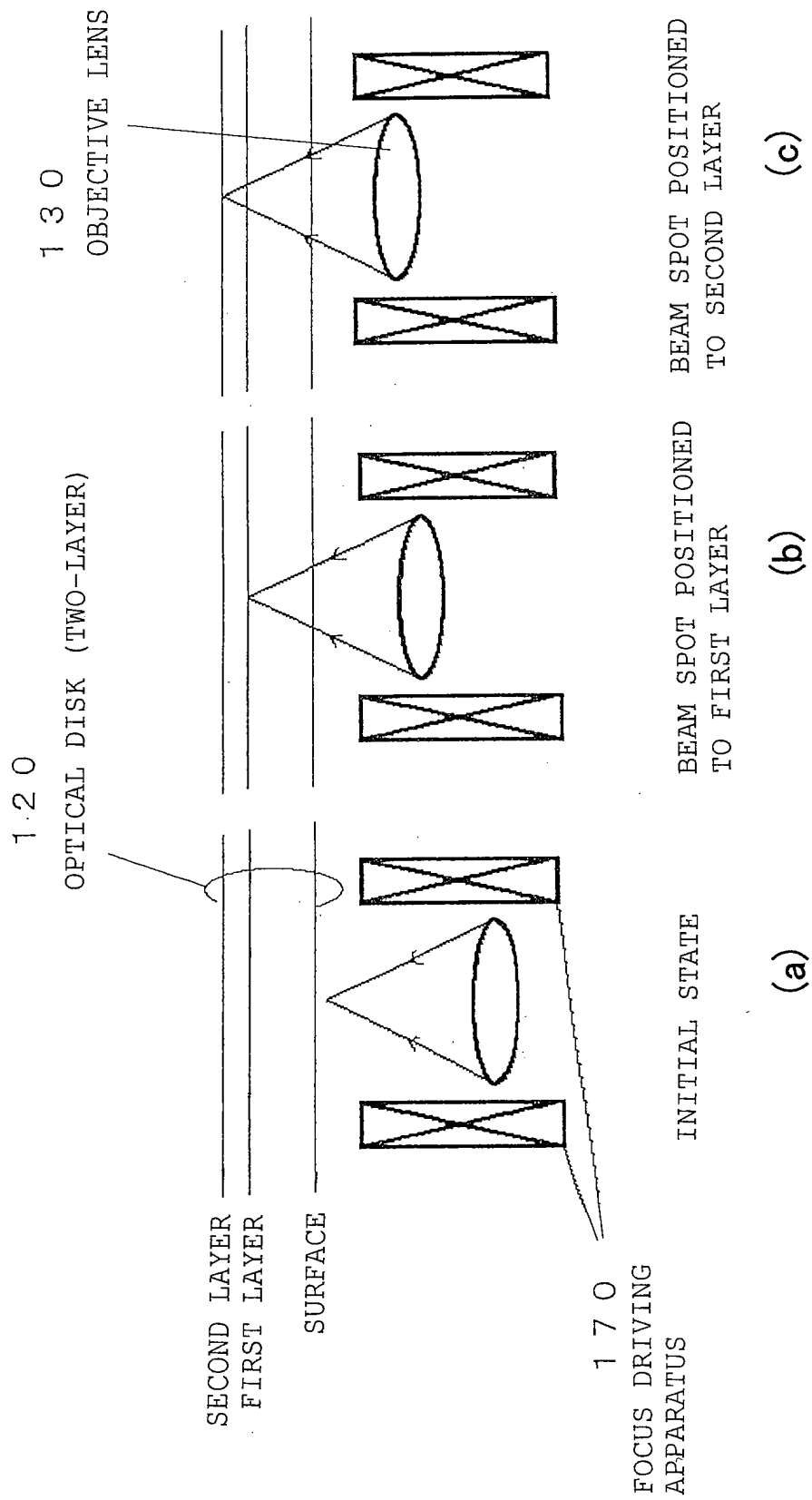


Fig. 13

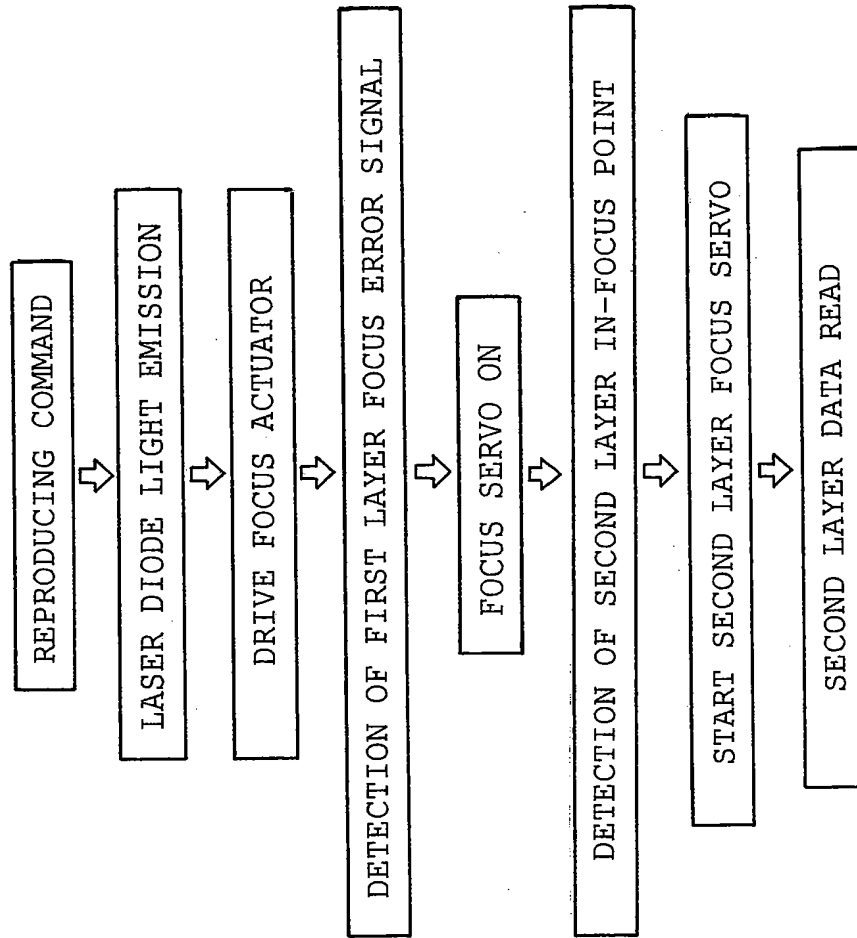


Fig. 14

- A FIRST LAYER FOCUS ERROR SIGNAL
 - B FIRST LAYER IN-FOCUS POINT
 - C SECOND LAYER FOCUS ERROR SIGNAL
 - D SECOND LAYER IN-FOCUS POINT
 - E FOCUS ERROR SIGNAL REFERENCE VOLTAGE
 - F FIRST LAYER FOCUS ERROR SIGNAL
- DETECTION SLICE LEVEL

